UNITED STATES MARINE CORPS
Logistics Operations School
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Training Command
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FESCR 8207

STUDENT HANDOUT

REPAIR STANADYNE FUEL INJECTION PUMPS

LEARNING OBJECTIVES

1. Terminal Learning Objective: Given a representative Stanadyne fuel injection pump, the required common and special tools, test equipment, repair parts, shop supplies, TM 00038G-35, TM 9-2815-237-34, TM 06858B/06859D-34, Stanadyne Service Publication No. 99009, and Hartridge 2500 Operating, Servicing, and Spares Manual, per information contained in the references, repair the fuel injection pump. (8.2.5)

2. Enabling Learning Objectives:

a. Given a Stanadyne DB2 fuel injection pump, the required common and special tools, test equipment, repair parts, shop supplies, TM 9-2815-237-34, Stanadyne Service Publication No. 99009, and Hartridge 2500 Operating, Servicing, and Spares Manual, per information contained in the references:

(1) disassemble the fuel injection pump, (8.2.5a)

(2) inspect the disassembled components for serviceability, (8.2.5b)

(3) repair or replace the unserviceable components, (8.2.5c)

(4) assemble the fuel injection pump, and (8.2.5d)

(5) calibrate the fuel injection pump. (8.2.5e)

b. Given a Stanadyne DCMFC fuel injection pump, the required common and special tools, test equipment, shop supplies, and TM 00038G-35, per information contained in the reference, repair the advance timing unit for that pump. (8.2.5f)

c. Given a Stanadyne DBMFC fuel injection pump, the required common and special tools, test equipment, shop supplies, and TM 06858B/06859D-34, per information contained in the reference, repair the advance timing unit for that pump. (8.2.5g)

OUTLINE

1. FUNCTION, DESIGN CHARACTERISTIC AND PRINCIPLES OF OPERATION OF THE DB2 INJECTION PUMP

a. The Stanadyne DB2 is a rotary distributor type pump with a single pumping element that supplies all eight engine cylinders. The actual pumping function is carried out in a single barrel which houses two opposing plungers. These plungers are pushed together by a lobed cam ring. The force of this action pressurizes the fuel. Since the number of lobes on the cam ring equals the number of cylinders in the engine, each thrust of the plunger by a cam lobe results in the distribution of a pulse of fuel to one particular cylinder.

b. Functions. The injection pump controls delivery of fuel to the engine in four important ways.

(1) Amount. It accurately meters the fuel according to engine power requirements.

(2) Pressure. It pressurizes the fuel to the level needed to open the nozzles.

(3) Distribution. It distributes the fuel to the nozzles in the firing order of the cylinders.

(4) Timing. It controls the time of injection.

c. Flow of Fuel Through the Fuel Injection Pump

(1) Fuel is drawn into the pump inlet by the vane type transfer pump. From the transfer pump, the fuel is routed in three different directions.

(a) Some fuel goes to the automatic advance mechanism.

(b) Some fuel goes through a vent wire assembly to the housing cover area and out the return fitting to the fuel tank.

(c) Most of the fuel is sent to the metering valve.

(2) The metering valve operates in two ways: by the throttle lever, when the vehicle is operating at intermediate speeds and by the governor linkage, when the vehicle is at minimum and maximum engine speeds.

(3) The metering valve allows a measured amount of fuel to pass into the center of the hydraulic head where the distributor rotor is turning.

(4) Fuel goes to the center of the rotor, which has two inlet passages at one end and an outlet passage at the other end.

(5) As the rotor turns, the inlet passages line up with ports in the hydraulic head. When this occurs, the fuel is forced into the pumping chamber.

(6) The pumping chamber consists of two sets of rollers, shoes, and plungers, which rotate inside a cam ring. The cam ring has eight lobes on the inside, one for each engine cylinder.

(a) The force of the fuel coming into the pumping chamber, together with the centrifugal force generated by the rotor, moves the plungers apart. The plungers move outward a distance which is directly proportional to the volume of fuel passing the metering valve.

(b) As the rotor turns, the rollers contact the peaks of the cam ring lobes, pushing the plungers together. It is this action which pressurizes the fuel to the degree required to open the nozzles.

(7) The fuel, which is now at injection pressure, is forced back along the center passage of the rotor and into the discharge port.

(8) The fuel is pumped out of the rotor when the discharge port of the rotor lines up with one of the discharge outlets in the hydraulic head. As the rotor turns, its single port discharges a pulse of fuel into each of the eight hydraulic head outlets in sequence. Each discharge fitting is connected to a nozzle by a high pressure line. The fuel is pumped through the discharge fitting, through the high pressure lines, and into the nozzle in the engine cylinder head.

(9) Fuel enters the nozzle at a rate and amount that varies with the demands of the engine. When the engine fuel demand is low, such as at idle, the fuel pulses are smaller and farther apart than when the engine is running at wide-open-throttle. At wide-open-throttle, larger amounts of fuel, spaced closely together, force the nozzles to open more often and to stay open longer to meet the needs of a high speed engine.

d. Components and Functions

(1) Vent Wire Assembly. The vent wire assembly controls the amount of fuel that is returned to the fuel tank from the injection pump, and is located in a short passageway behind the metering valve bore.

(a) Excess fuel coming from the transfer pump flows past the vent wire, taking any air which has entered the transfer pump along with it. After the fuel passes by the vent assembly, it enters the governor compartment. From here, excess fuel leaves the pump through the returnline.

(b) The amount of fuel that enters the return line is controlled by the size of the wire in the assembly. If the amount of return fuel does not meet specification requirements, the existing vent wire can be exchanged for one of a different size.

(2) Delivery valve. A delivery valve, located in the center of the distributor rotor, helps the nozzle to reseat rapidly and prevents fuel which is not atomized from dribbling into the precombustion chamber. Pressurized fuel coming from the pumping chamber forces the delivery valve plunger slightly out of its bore. Fuel goes past the plunger and out the discharge port. When fuel pressure drops, the delivery valve plunger immediately reseats, causing a rapid drop in injection line pressure.

(3) Advance mechanisms. There are three mechanisms on the Stanadyne DB2 fuel injection pump which serve to advance injection timing: the automatic advance system, the mechanical light load advance, and the housing pressure cold advance (HPCA) solenoid.

(a) The automatic advance mechanism advances and retards the start of fuel delivery. This mechanism starts working during high speed driving to ensure that the fuel pulse arrives at the cylinder in time for the compression stroke, just before the piston reaches top dead center. This is when compression is at its highest point. If it were not for the advance mechanism, the fuel wouldn't arrive at the cylinder before the piston had already started downward on the power stroke. Thus, the automatic advance mechanism aids in smooth engine performance.

1 The mechanism consists of a power piston, a servo valve, a servo spring, a servo piston, and a cam advance pin.

2 The cam advance pin links the advance mechanism to the cam ring. This pin is connected to the advance mechanism at its lower end and to the cam ring at its upper end. In this way, when the advance piston shifts position, the cam ring also shifts position because of the linkage provided by the cam pin. This movement, or rotation of the cam ring, results in the advance of fuel delivery.

3 The action of the power and servo pistons is dependent upon fuel pressure from two sources: the housing pressure behind the servo piston and the transfer pressure behind the power piston. When the vehicle is cranking, the fuel behind the servo piston is at housing pressure, and the power piston is seated against the housing. As the vehicle speed increases, the transfer pressure rises as a result of increasing pump speed. When this happens, the transfer pump sends fuel to a chamber behind the power piston.

4 When transfer pressure behind the power piston exceeds housing pressure, the force of this accumulating fuel overcomes the resistance of the servo piston and spring, and the power piston shifts position. The power piston pushes the cam advance pin and rotates the cam ring in the direction opposite to the rotation of the distributor rotor and the rollers, shoes, and plungers. Because of this rotation, the rollers contact the cam lobes earlier and injection timing is advanced. When the transfer pressure drops, the timing will be retarded because the cam ring will rotate in the other direction.

(b) The light load advance mechanism provides advance when the engine is operating at low speed or at light load, when the transfer pressure is too low to move the advance piston.

1 The light load advance consists of an external face cam and rocker lever assembly. At the top of the pump, this assembly is connected to the throttle shaft. At the lower end, the rocker lever contacts the protruding end of the servo advance plunger.

2 The throttle shaft moves the face cam and lever assembly, which in turn move the servo plunger toward the cam pin. This action changes the reference point of the servo spring. At a predetermined angle, the surface of the face cam becomes a flat plane, so that further throttle movement does not affect the servo plunger and the spring reference point becomes fixed.

3 After this point, advance action is regulated by transfer pump pressure, as was discussed earlier.

(c) The housing pressure cold advance (HPCA) solenoid is one of the three solenoids which affect the operation of the injection pump. The HPCA solenoid makes it easier to start the vehicle in cold weather by reducing the housing pressure in the advance mechanism.

1 The HPCA solenoid is located at the return fitting, under the pump housing cover.

2 The HPCA solenoid is activated by the coolant temperature switch which is mounted on the engine. When coolant temperature is low, the solenoid is energized and the plunger is extended to lift the check ball off its seat. With the check ball out of place, the housing pressure is reduced to almost zero. With practically no housing pressure to overcome, the transfer pump pressure behind the power advance piston can easily advance the cam ring.

(4) In addition to the housing pressure cold advance (HPCA) solenoid, there is a fuel shut-off solenoid located inside the pump housing cover that stops the engine by cutting off the fuel flow.

(a) The fuel shut-off solenoid acts on the governor linkage hook to rotate the metering valve.

(b) When the ignition is turned off, the solenoid is de-energized and the return spring pulls the solenoid arm to the "OFF" position.

(c) The movement of the arm to the "OFF" position moves the governor linkage hook, rotating the metering valve to cut off fuel delivery.

(5) The min-max governor, located under the governor cover maintains idle speeds with varying engine loads and also limits the maximum speed of the engine.

(a) The main components of the governor are: the governor weights, the governor arm, the low idle spring, the idle spring guide, the main governor spring, the main governor spring guide, and the guide stud.

(b) The governor weights spin around with the rotation of the drive shaft. Their centrifugal force controls the metering valve at minimum and maximum engine speeds.

(c) At idle speed, the governor weights exert very little force, so the spring on the governor keeps the metering valve almost closed.

(d) At high engine rpm, the force of the governor weights moves a pivot arm, compresses the spring, and rotates the metering valve to an almost closed position.

(e) At intermediate speeds, the vehicle operator directly controls the metering valve through the throttle. In this case, the force of the governor weights and the min-max spring tension are balanced, so neither has the power to control the metering valve.

(6) Pressure regulator. The pressure regulator protects the transfer pump from being damaged as a result of excessive output pressure. Pressure can become excessive, either because of increased pump speeds or because of restrictions in the fuel return line. The pressure regulator valve relieves this pressure when it reaches a preset limit.

(a) With the valve closed under normal operating conditions, the valve spring holds the piston forward, blocking the regulating slot in the valve. Under this condition, the valve has no affect on the system.

(b) As output pressure increases, the valve opens. High pressure fuel pushing on the face of the valve piston compresses the spring. If the pressure is high enough to overcome the force of the spring, the piston will be pushed back, uncovering the regulating slot in the valve. Fuel is allowed to flow back to the input side of the pump, relieving the output pressure.

(c) A viscosity compensating device maintains the constant pressure of fuel, regardless of variations in fuel viscosity. This device is incorporated into the design of the pressure regulator mechanism.

2. PROCEDURES REQUIRED TO REPAIR THE STANADYNE DB2 FUEL INJECTION PUMP

a. Cleaning the Fuel Pump Before Disassembly

(1) Find the procedures for cleaning the pump before disassembly in TM 9-2815-237-34. Read the procedures completely to become familiar with the total task.

(2) Explain to the instructor the procedures for cleaning the pump.

Have instructor initial.

b. Disassembly of the Fuel Pump

(1) Find the procedures for disassembly in TM 9-2815-237-34. Read the procedures completely to become familiar with the total task.

(2) Disassemble the pump.

(a) Remove the governor cover.

(b) Remove the rocker arm.
(c) Remove the face cam.

(d) Remove the guide stud.

(e) Remove the min-max governor assembly.

(f) Remove the spring assembly from the push rod.

(g) Remove the idle spring from the guide.

(h) Remove the spring and washer from the rod.

(i) Remove the throttle shaft.

(j) Remove the governor arm and linkage.

(k) Remove the metering valve.

(l) Remove the vent wire.

(m) Remove the end-cap locking screw, and end-cap.

(n) Remove and disassemble the regulator assembly.

(o) Remove the transfer pump blades and liner.

(p) Remove the end-cap seal.

(q) Remove the head locking screws and the locating screw.

(r) Remove the advance screw hole plug.

(s) Remove the servo advance plunger.

(t) Remove the side hole plug.

(u) Remove the mechanical light load advance spring and servo valve.

(v) Remove the power side advance piston hole plug.

(w) Remove the cam advance pin.

(x) Remove the advance piston.

(y) Remove the hydraulic head assembly.

(z) Remove the thrust sleeve, weights and washer from the head.

(aa) Remove the liner locating ring and rotor retainers.

(bb) Remove the snap ring.

(cc) Remove the weight retainer.

(dd) Remove the cam ring.

(ee) Perform roller-to-roller dimension check. Record reading .

Have instructor initial.

(ff) Remove the rollers and shoes.

(gg) Remove the plungers.

(hh) Remove the leaf spring.

(ii) Remove the delivery valve, stop, and spring.

(jj) Remove the drive shaft.

Have instructor initial.

c. Inspect the Fuel Pump Components

(1) Find the procedures for inspection in TM 9-2815-237-34.

(2) Explain and demonstrate to the instructor the procedures for inspecting the components.

Have instructor initial.

d. Assembly of the Fuel Pump

(1) Find the procedures for assembly in TM 9-2815-237-34. Read the procedures completely to become familiar with the total task.

(2) Install the drive shaft.

(3) Assemble the rotor.

(a) Install the delivery valve, spring, and stop.

(b) Install the pumping plungers.

(c) Install the leaf spring, shoes, and rollers.

(d) Adjust roller-to-roller dimension.

(e) Perform the centrality check.

Have instructor initial.

(4) Assemble the head.

(a) Install the head seal.

(b) Install the rotor assembly into the hydraulic head.

(c) Install the cam ring.

(d) Install flexible retaining ring on the weight retainer.

(e) Install the weight retainer.

(f) Install the snap ring.

Have instructor initial.

(g) Install the end-cap seal.

(h) Install the rotor retainers.

(i) Install the locating ring.

(5) Assemble the transfer pump.

(a) Install the pump liner.

(b) Install the pump blades.

(6) Assemble the regulator assembly.

(a) Install the screen seal.

(b) Install the regulating piston, spring, and adjusting plug.

(c) Check the piston movement.

(d) Install the regulator.

(e) Install the screen filter.

Have instructor initial.

(f) Install the end-cap.

(7) Assemble the governor.

(a) Install the governor weights.

(b) Install the thrust washer.

(c) Install the thrust sleeve.

(8) Assemble the head into the pump housing.

(a) Install the hydraulic head. (Aline timing marks.)

(b) Install the head locking screws.

Have instructor initial.

(9) Install the head locating screw into the pump.

(10) Install the automatic advance assembly.

(a) Install the advance piston.

(b) Install the cam pin.

(c) Install the servo valve and spring.

(d) Install the advance hole plugs.

(e) Install the servo advance plunger.

(11) Install the vent wire into the head.

(12) Install the metering valve into the head.

(13) Install the governor arm to the pump housing.

(14) Install the throttle shaft into the pump housing.

(15) Assemble the governor capsule.

(a) Install the washer and spring to the rod.

(b) Install the block.

(c) Install the governor capsule to the pump.

(16) Install the guide stud into the pump.

Have instructor initial.

(17) Install the mylar washer, face cam, and rocker arm.

(18) Set the linkage gap.

(a) Prior to measuring and adjusting the linkage gap, hold the throttle lever in wide-open-throttle position and rotate the drive shaft in the proper direction of rotation until a slight "click" is heard, as the toes of the governor arm engage slots in the thrust sleeve. The torque screw (if used) should be backed out.

(b) With the throttle lever held in the wide-open-throttle position, use the linkage go-no-go gauge to check the clearance between the rear of the shut-off shaft and the vertical tab on the linkage hook.

(c) Adjustment of this clearance is made by using the linkage wrench to change the effective length of the linkage hook. Loosen the adjusting screw and slide the linkage to maximum open length. Insert the small arm of the linkage go-no-go gauge between the vertical tab and shut-off shaft, and slide linkage hook together from the rear until face of tab is flush against the gauge. Tighten adjusting screw.

(d) Check the adjustment and reset if required.

(19) Install the governor cover.

(20) Torque the transfer pump end-cap.

(21) Adjust the throttle lever.

Have instructor initial.

4. CALIBRATE THE FUEL PUMP. Since you have already had a period of instruction on the operation of the 2500 test stand, you should have no problem calibrating the DB2 injection pump by following the calibration

procedures contained in your student handout. However, there will be an instructor present at all times while you calibrate the pump. Follow the procedures very carefully.

a. Mount DB2 Fuel Injector Pump to Test Stand

(1) Find the diagram in the Hartridge 2500 Operating, Servicing, and Spares Manual, for mounting the DB2 pump to the test stand.

(2) Mount the pump on the test stand according to the manufacturer's instructions.

(3) Install the applicable transfer pump inlet connector. Attach the injection lines to the discharge fittings.

(4) Install the transfer pressure tap (part no. 21900) and connect it to the pressure gauge.

(5) Install the advance gauge (part no. 21734) by removing the timing line cover and seal from the pump and attaching the gauge to the pump with the screws provided. A 9/32 in. hex wrench will work for this job.

(6) Install the gauge line to the housing pressure tap, which is located at the bottom of the advance gauge.

(7) Connect the 12 volt positive lead from the variable voltage supply to the fuel shut-off solenoid.

(8) Connect a throttle positioning device to hold the throttle in various fixed positions.

b. General Instructions

(1) Some fuel injection pump delivery specifications are stated in cubic millimeters per stroke. The Hartridge Model 2500, such as those used at school and those used throughout the Marine Corps, measures fuel delivery in cubic centimeters per one thousand strokes. As a result of this, cubic millimeters per stroke must be converted to cubic centimeters per one thousand strokes so we can effectively read fuel delivery rates on the Hartridge 2500.

(a) The conversion of cubic millimeters to cubic centimeters is a simple mathematical computation. Here's how its done.

1 First of all, you must be armed with the fact that one cubic centimeter contains one-thousand cubic millimeters.

2 With that known, you simply take the injection pump fuel delivery specification stated in cubic millimeters per stroke, and divide that by one-thousand because there are one-thousand cubic millimeters per cubic centimeter. The result of that computation gives you the fuel delivery rate in cubic centimeters per stroke.

(b) To complete the calculation, you then simply multiply the cubic centimeters by the number of strokes used for the fuel delivery measurement, in this case, one thousand strokes. The formula looks like this:

$$\frac{\text{cu mm/stroke X 1000}}{1000} = \text{cu cc per 1000 strokes}$$

(2) All fuel readings should be taken at 1000 strokes.

(3) When you check and measure the graduated cylinders for fuel delivery, observe the following:

(a) After each test, note if the level of fuel in all of the cylinders is roughly the same. If any one of the cylinders contains more or less than 6 cc's per 1000 strokes than that of the average level of all of the cylinders, the transfer pump should be checked for worn, damaged, or wrong size blades or liner.

(b) Take the fuel measurement from the lower line that you see on the surface of the fuel.

(4) The fuel shut-off solenoid is to remain energized unless otherwise specified.

(5) Housing pressure cold advance (HPCA) solenoid de-energized unless otherwise specified.

(6) Supply pressure must be constant throughout the entire operating range. This should average 5 psi.

(7) The return line must be free of any restrictions.

(8) Vacuum, anything less than atmospheric pressure, at the transfer pump must be avoided.

c. Prepare Pump and Test Stand for Calibration

(1) Set the D.C. voltmeter on the test stand to read 12 volts. Operate the pump at 500 test stand RPM wide-open-throttle, for ten minutes to bring the system to an operating temperature of 110 degrees Fahrenheit to 115 degrees Fahrenheit or 42 degrees Celsius.

(2) Dry the pump completely with compressed air and check for any leaks. Correct as necessary.

(3) Fill the graduated cylinders to bleed all the air from the test stand and to wet the graduates. Push the count button on the test stand.

d. Set Transfer Pump Pressure

(1) The purpose is to set the transfer pump pressure to specifications. Using a 5/32 inch Allen wrench, adjust the pressure to 58 to 64 psi (61 psi average), following these procedures.

(a) Adjust the supply pressure to 4.5 to 5.5 psi (5 psi average).

(b) Operate the pump at 1000 rpm, wide-open-throttle, and observe the transfer pump pressure gauge.

(c) If transfer pump pressure is not within specification, set the pressure by adjusting the regulator plug as follows:

1 Stop the test stand.

2 Disconnect the fuel line at the pump inlet.

3 Insert the wrench into the pump inlet until it engages the regulator plug.

4 Turn the wrench to change the transfer pump pressure. A clockwise turn will increase pressure; a counterclockwise turn will decrease pressure.

5 Continue to adjust and recheck until transfer pump pressure is correct.

(2) Record transfer pump pressure:

e. Check Transfer Pump Vacuum. The purpose is to determine the serviceability of the transfer pump by checking its vacuum or lift. The specification is 18 inches of mercury minimum. Follow these procedures.

(1) Run the pump at 200 rpm and check the vacuum gauge.

(2) Turn test stand pressure valve control counterclockwise until it stops.

(3) If the vacuum does not come within specification, check for air leaks between the shut-off valve inlet and the shut-off valve, or check for a defective transfer pump component.

(4) When the check is complete, turn the pressure back on and readjust the transfer pump pressure to specification if required. Record transfer pump pressure:

f. Set Return Oil. The purpose is to determine whether or not the return oil system is operating properly, and that the vent wire assembly is the correct size. The specification is a flow rate of 225 to 375 cc's per minute. Follow these procedures:

(1) Operate the pump at 1000 rpm, wide-open-throttle.

(2) Check return oil.

(3) If the return oil flow does not meet specification, the size of the vent wire in the pump can be changed to adjust the flow rate.

(4) A smaller vent wire will let more fuel return, a larger vent wire will let less fuel return. Record flowmeter reading:

g. Check Housing Pressure

(1) Operate the pump at 300 rpm with the throttle in the low-idle position.

(a) Check housing pressure. Pressure should be 8 to 12 psi.

(b) Set D.C. voltmeter on the test stand to read 8.8 volts.

(c) Use a jumper lead from the shut-off solenoid connecter to the HPCA connector and Energize the (HPCA) solenoid using 8.8 volts.

(d) Read the housing pressure gauge. Pressure should be 0 to 1 psi.

(2) If housing pressure indicates that the HPCA solenoid has not operated properly, the solenoid should be replaced.
Record housing pressure: _____(HPCA solenoid not energized)

Record housing pressure: _____(HPCA solenoid energized)

h. Set Min-Max Governor

(1) The purpose is to attain the correct setting of the governor assembly to deliver a specified amount of fuel at low-idle. Using an 11/32 inch open end wrench and a small flat blade screwdriver, set the governor to deliver 12.5 to 16.5 cc's per 1000 strokes at 300 rpm. Follow these procedures:

(a) Operate the pump at 300 rpm, with the throttle in the low-idle position.

(b) Check fuel delivery in graduated cylinders.

(2) If fuel delivery is not within specification, perform the following procedure:

(a) Shut off the pump.

(b) Remove the governor cover.

(c) Using an open end wrench, turn the hex nut at the governor block to adjust the fuel flow. (To increase fuel flow, lengthen the large spring; to decrease fuel flow, shorten the large spring.) Make this adjustment in small increments.

(d) Install the governor cover and retest.

(3) Repeat this procedure until the proper setting is achieved. Record average fuel delivery:

i. Check Electric Shut-Off Solenoid

(1) The purpose is to determine the serviceability of the fuel shut-off solenoid. The solenoid should pull in when 8.8 volts are applied to the solenoid. Follow these procedures:

(a) Operate the pump at 200 rpm with the throttle in the low-idle position.

(b) Turn the D.C. indicator knob on the test stand to indicate "O" on the dial.

(c) Observe the flow of fuel; fuel should cease to flow.

(d) Slowly turn the D.C. indicator knob until the fuel solenoid kicks in.

(e) Observe the flow of fuel; fuel should flow into the graduated cylinders.

(2) If the solenoid fails to pull itself in so that fuel will flow, it should be replaced.

Record solenoid pull in. (circle one)

YES NO

j. Set Cam Advance. The purpose is to set the cam advance and check the fuel delivery at part load. Using a torx socket, 3/8 drive ratchet, small flat blade screwdriver, torque wrench, feeler gauge, and a face cam torque socket, adjust the throttle to the specification of 21.5 to 23.5 cc's per 1000 strokes at 750 rpm, and cam advance to 2.5 degrees to 4.5 degrees. Follow these procedures:

(1) Move the throttle to the wide-open-throttle position and rotate the face cam to its maximum position counterclockwise.

(2) Operate the pump at 100 rpm and, while reading the left side of the gauge, adjust the advance gauge to "O."

(3) Operate the pump at 1000 RPM and adjust the trimmer screw to obtain 1.5 degrees on the advance gauge.

(4) Operate the pump at 750 rpm and adjust the throttle until the fuel delivery is 21.5 to 23.5. (This throttle adjustment will alter the cam advance movement.)

(5) Once the fuel delivery reaches specification, lock the throttle lever into position. Mark the throttle lever for future reference point.

(6) Adjust the face cam to reset cam advance until it comes within specification, 2.5 to 4.5 degrees. (Do not readjust trimmer screw.)

(7) When the correct setting is reached, torque the face cam screw and check the face cam retention using the following procedures:

(a) Check the clearance between the throttle spacer and housing boss with the feeler gauge to maintain a clearance of .004 to .006 inch.

(b) Torque the face cam screw to 28 to 32 inch-pounds.

(c) Lock throttle lever in wide-open-throttle position, install the face cam torque socket tool on the throttle shaft, engage the face cam, and apply a torque of 22 inch-pounds to the face cam. The face cam should not rotate on the shaft.

(d) If rotation of the face cam occurs at or below 22 inch-pounds, remove the face cam and inspect the throttle shaft for wear. If no throttle shaft wear is evident, install a new face cam and screw, recalibrate the pump, and repeat this torquing procedure.

Record fuel delivery:

Record cam advance:

Face cam rotation at or below 22 inch-pounds? (circle one)

YES NO

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k. Set Throttle Travel

(1) The purpose is to set the maximum travel of the throttle lever. Using a throttle lever protractor, set the throttle angle at wide-open-throttle position to the specification of 73 degrees to 82 degrees. Follow these procedures:

(a) Operate the pump at 750 rpm.

(b) Set the throttle for 19.5 to 25.5 cc's per 1000 strokes and lock into position. (The throttle lever should be marked for delivery of 21.5 to 23.5 cc's per 1000 strokes. If it is, reposition the lever and check delivery.)

(c) Install the throttle lever protractor onto the throttle shaft.

(d) Aline the "O" degree on the protractor with the center rib of the rocker lever.

(e) Unlock the throttle lever and rotate it to 56.5 degrees toward the wide-open-throttle position. Set the travel screw to this 56.5 degrees setting. (You may need to use a heat gun to loosen the travel screw.)

(2) Check the total throttle travel.

(a) With the throttle in the wide open position, aline the "0" degrees of the protractor with the center rib of the rocker lever.

(b) Move the throttle to the low-idle position. The reading on the protractor should be between 73 degrees to 82 degrees.

Record throttle angle:

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l. Perform Specification Checks. The purpose is to determine if the pump is operating according to the manufacturer's specifications. Follow these procedures:

(1) Check the integrity of the pump metering valve and linkage.

(a) Operate the pump at 750 rpm, wide-open-throttle.

(b) De-energize the fuel shut-off solenoid.

(c) Fuel delivery should be a maximum of 4 cc's per 1000 strokes.

(d) Re-energize the solenoid.

Record average fuel delivery:

(2) Check for maximum fuel delivery at cranking and for integrity of head and rotor.

(a) Operate the pump at 75 rpm, wide-open-throttle position.

(b) Fuel delivery should be 28 cc's per 1000 strokes minimum.

(c) Transfer pump pressure should be 12 psi minimum.

Record average fuel delivery:

Record transfer pump pressure:

(3) Check the operation of the housing pressure cold advance (HPCA) solenoid.

(a) Operate pump at 300 rpm, low-idle throttle position.

(b) Fuel delivery should be 12.5 to 16.5 cc's per 1000 strokes. (Adjust low idle screw)

(c) Cam movement should be 1.5 degrees minimum.

(d) Energize the HPCA solenoid. The cam advance movement should be 2.25 degrees minimum and the housing pressure should be 0 to 1 psi.

(e) De-energize the solenoid.

Record average fuel delivery:

Record cam movement (HPCA solenoid de-energized):

Record cam movement (HPCA solenoid energized):

Record housing pressure (HPCA solenoid energized):

(4) Check the correlation between the pump timing and metering.

(a) Operate the pump at 750 rpm.

(b) Move the throttle until you get a fuel delivery of 21.5 to 23.5 cc's per 1000 strokes

(c) Cam advance movement should be 2.5 to 4.5 degrees.

(d) Housing pressure should be 8 to 12 psi.

Record average fuel delivery:

Record cam advance movement:

Record housing pressure:

(5) Check the fuel delivery at peak torque, roller-to-roller set point.

(a) Operate pump at 1000 rpm, wide-open-throttle.

(b) Fuel delivery should be 47.5 to 51.5 cc's per 1000 strokes.

(c) Housing pressure should be 8 to 12 psi.

(d) Cam movement should be .5 to 2.5.

Record average fuel delivery:

Record housing pressure:

Record cam movement:

(6) Check the timing advance.

(a) Operate the pump at 1600 rpm, wide-open-throttle.

(b) The cam advance should read 4.25 degrees to 6.75 degrees.

(c) Move throttle to the low-idle position.

(d) The cam advance should read 10 degrees maximum.

(e) Housing pressure for both settings should be 8 to 12 psi.

Record cam advance at wide-open-throttle:

Record cam advance at low-idle:

Record housing pressure:

(7) Check the maximum fuel delivery.

(a) Operate the pump at 2000 rpm, wide-open-throttle.

(b) Fuel delivery should be 40 cc's per 1000 strokes minimum.

(c) Housing pressure should be 8 to 12 psi.

Record average fuel delivery:

Record housing pressure:

(8) Check the governor cut-out.

(a) Operate the pump at 2200 rpm, wide-open-throttle.

(b) Fuel delivery should be 4.0 cc's per 1000 strokes maximum.

(c) Transfer pressure should be 125 psi maximum.

Record average fuel delivery:

Record transfer pump pressure:

Have instructor initial.

(9) If any changes or adjustments were made during the specification checks, the pump would require a retest, beginning with the cam advance setting procedure.

(10) If the pump checked out within specifications, remove it from the test stand, install a new vacuum module drive pin through the throttle shaft, and coat the seal fasteners with sealing lacquer as follows:

(a) Apply lacquer at the screw, washer and cover interface located at the left front governor cover, as viewed from the drive shaft end.

(b) Apply lacquer at the face cam screw head and cam interface.

(c) Completely fill the rocker lever screw hex head.

m. Check Air Timing

(1) The purpose of this check is to determine if the pump is properly timed to the engine. Using the air timing tool, filtered air, a file, hammer, and a clean rag, follow these procedures to check the timing.

(a) Set the air timing tool to the -.25 to +.75 position.

(b) Rotate the pump drive shaft to locate the dowel pin of the pump at the seven o'clock position, as viewed from the drive end.

(c) Connect a supply of dry filtered air at 60 to 100 psi to the number "1" discharge fitting. The number "1" fitting can be identified by the number "1" cast into the housing next to it.

(d) Install the air timing tool to the pump, making certain that the dowel pin engages the hole in the tool.

(e) Rotate the air timing tool in the direction of normal drive shaft rotation. Correct rotation can be determined by the directional arrow cast into the housing next to the number "1." Rotate the tool until the cam rollers can be felt making contact with the cam ring. Repeat this action several times by turning the fixture opposite the direction of rotation and then back again in the direction of rotation until you get a positive feeling for when the rollers first make contact with the cam ring. This point indicates the beginning of injection. Lock fixture in place by tightening the knurled screw.

(f) Remove the scribe device from the body of the tool and replace it with the optical device.

(g) Check the timing mark with the optical gauge. The mark on the pump flange should be clearly in line with the line on the optical gauge.

(2) If the timing mark on the pump flange is incorrect and needs to be changed, use the following procedure:

(a) Remove the timing tool from the pump.

(b) Cover the drive shaft and pilot area of the pump with a clean rag to keep filings from entering the bearing and seal area.

(c) Remove the incorrect mark with a file. Clean the flange with compressed air.

(d) Reinstall the timing tool to the pump.

(e) Remove the optical gauge from the tool and replace it with the scribe device.

(f) Repeat the procedures in steps 3 and 4 for finding the beginning of injection.

(g) Lock the tool to the pump and tap the scribe device with a mallet to place a new timing line on the pump flange.
Is timing mark correct? (circle one)

YES NO

REFERENCES:

TM 00038G-35
TM 9-2815-237-34
TM 06858B/06859D-34
Stanadyne Service Publication No. 99009
Hartridge 2500 Operating, Servicing, and Spares Manual